Sinoconodon

Sinoconodon rigneyi[1] is an ancient mammaliamorph or early mammal (depending on systematic approach) that appears in the fossil record of the Lufeng Formation of China in the Sinemurian stage of the Early Jurassic period, about 193 million years ago.[2] While in many traits very similar to non-mammalian synapsids, it possessed a special, secondarily evolved jaw joint between the dentary and the squamosal bones, which had replaced the primitive tetrapod one between the articular and quadrate bones, a trait commonly used to define mammals.[3][4]

Although the animal is closely related to *Morganucodon*, it is regarded as the most basal of the mammaliaforms.[5] It differed substantially from the more mammalian *Morganucodon* in its dental and growth habits. Like other non-mammalian tetrapods, such as reptiles and amphibians, it was polyphyodont, replacing many of its teeth throughout its lifetime, and it seems to have grown slowly but continuously until its death. *Sinoconodon* is thus less mammalian than early mammaliaforms like docodonts and morganucodonts.[3][6] The dentition of *Sinoconodons* can be arranged in a series of increasing lengths[7] The combination of basal tetrapod and mammalian features makes it a unique transitional species. There are simply no animals like it alive today.[8]

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Taxonomy

Sinoconodon was named by Patterson and Olson in 1961. Its type is *Sinoconodon rigneyi*. It was assigned to Triconodontidae by Patterson and Olson in 1961; to Triconodonta by Jenkins and Crompton in 1979; to Sinoconodontidae by Carroll in 1988; to Mammaliamorpha by Wible in 1991; to Mammalia by Luo and

Sinoconodon

Temporal range: Sinemurian

~193 Ma

Pre€ € O S D C P T J K PgN

Restoration of *S. rigneyi*

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Clade:	Therapsida
Clade:	Cynodontia
Genus:	†*Sinoconodon* Patterson & Olson, 1961
Species:	†***S. rigneyi***

Binomial name

†***Sinoconodon rigneyi***
Patterson & Olson, 1961

Synonyms

List

Genera

- *Lufengoconodon* Young 1982a

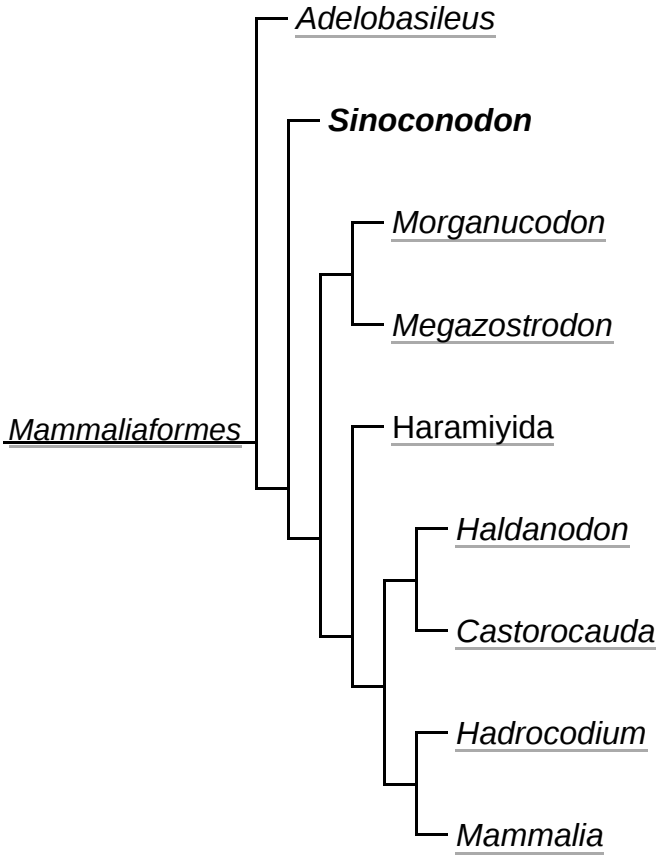
Species

- *Lufengoconodon changchiawaensis* Young 1982a
- *Sinoconodon changchiawaensis* (Young 1982) sensu Crompton & Sun 1985

Wu in 1994; to Mammalia by Kielan-Jaworowska et al. in 2004; and to Mammaliaformes by Luo et al. in 2001 and Bi et al. in 2014.[9]

- *Sinoconodon parringtoni* Young 1982
- *Sinoconodon youngi* Zhang 1983

Phylogeny



Sinoconodon[10][11] differs from all nonmammalian cynodonts in the presence of a promontorium, an enlarged anterior lamina, and the floor of the trigeminal ganglion. *Sinoconodon* shares several derived characters with other mammals. The most distinguished are the expansion of the brain vault in the parietal region, complete ossification of the medial wall of the orbit, a large dentary condyle, and a concave glenoid fossa in the squamosal. These characters suggest that *Sinoconodon* and other mammals form a monophyletic group. In addition, *Sinoconodon* developed some autapomorphic characters: a large occipital condyle; and, relative to skull length, postdentary bones more reduced in size than in the other known Liassic mammals. These characters suggest that *Sinoconodon* is the sistergroup to a taxon that includes all other mammals because *Sinoconodon* lacks a number of diagnostic apomorphies shared by *Morganucodon*, *Dinnetherium*, and other mammals.[10][12]

Relationships

The evolutionary transition to the mammalian type of jaw joint was associated with changes in body size, structure of the ear, structure of the skull, structure of the teeth, and, consequently, the type of diet that distinguishes mammals from other vertebrates. *Morganucodon* can still be regarded as the best known of the earliest mammals. The skull, lower jaw, and postcrania of this small mouse-sized mammal are well preserved and have provided the basis for many ideas of mammal origins.

Sinoconodon presents morphological data that forces a modification of ideas of mammal origins based primarily on *Morganucodon*. *Sinoconodon* is known only from the skull and lower jaws. It is younger geologically than some *Morganucodon*, but *Sinoconodon* has many features which are more primitive than *Morganucodon*. Particularly significant is the dentition of *Sinoconodon*, in which the postcanine tooth row consists of five multicuspid trenchant teeth with only the vestiges of cingula. These teeth do not precisely occlude with one another. They do not look like typical mammalian teeth, which do occlude precisely and have distinct cingula and cusps offset from a single longitudinal row. Indeed, precise occlusion is thought to have evolved very early in the evolution of mammals, in *Morganucodon* itself.[13]

Description

Jaw and Skull

A lack of morphological information makes it difficult to interpret the relationships of advanced cynodonts and early mammals. To address this problem, skulls and dentition of *Sinoconodon* and *Morganucodon* were studied.[7] Among all known skull specimens of *Sinoconodon*, the smallest is a length of 14mm from the rostrum to the posterior end of the tooth row (skull length estimated between 20 and 22mm). Dental replacement in *Sinoconodon* is characterized by more than three replacements of the incisors, at least five replacements of the canines, and one replacement of the premolars and the posterior molars, as seen in many non-mammalian cynodonts. The replacing the premolars and the anterior molars are permanently lost, enlarging the post canine diastema in the older specimens. The single replacement of at least some posterior molars and the differentiation of premolars from molars may be a general condition in the stem group of mammals.[14]

The skull experienced indeterminate growth while the teeth were being replaced in adult specimens. The dental replacement of *Sinoconodon* could be interpreted as an intermediate stage in the character evolution from the primitive pattern of polyphyodont replacement seen in most cynodonts to the derived diphyodont replacement of mammals. From the polypyodont replacement and the substantial growth of the adult skulls of *Sinoconodon*, it is inferred tat this taxon lacked the lactation and determinate growth of living mammals.[14]

In other aspects *Sinoconodon* is more primitive; precise post-canine occlusion is lacking, the mandibular symphysis is deep, the jaw articulation lies below a line projected through the apices of the teeth, the pterygoparoccipital foramen is large and the post-canine teeth cannot be divided into molars and premolars. The jaw articulation and braincase of *Sinoconodon* are compared with those of the two cynodont therapsids *Probainognathus* and *Thrinaxodon.* It is concluded that in the transition from therapsid to mammal the medial surface of the groove in the squamosal housing the quadrate was lost and, as a result, in *Sinoconodon*, *Morganucodon* and *Dinnetherium* the hollow medial surface of the quadrate abutted directly against the paroccipital process.[7][15] *Morganucodon* are more closely related to the crown group than is *Sinoconodon* due to the upper and lower molars have one-to-one occlusal relationship and the opposing molars develop wear facets from this precise deal occlusion. *Morganucodon* are also more similar to the crown mammalian group than *Sinoconodon* in a number of features of the cranio-mandibular joint, a longer cochlear canal, and a slightly larger cranial capacity.[13]

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External links

- Mammaliformes from Palaeos (http://palaeos.com/vertebrates/mammaliformes/index.html)

- http://fossilworks.org/bridge.pl?a=taxonInfo&taxon_no=203414
- http://eol.org/pages/10575421/names?all=1
- http://palaeos.com/vertebrates/mammaliformes/mammaliformes.html#Mammaliformes

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